

**Non-Point Source Pollution Sampling Report for
Paugus Bay, Lake Winnepesaukee
Laconia, New Hampshire**

DRAFT

**Conducted by
Laconia Watershed Advisory Committee
for the Laconia Planning Board**

Fall 2003

TABLE OF CONTENTS

1.0	Executive Summary	4
2.0	Introduction	7
3.0	Background	7
4.0	Sampling Plan and Rationale	8
5.0	Summary of Other Sampling	10
	Laconia Water Department	10
	University of New Hampshire – MTBE Study	12
6.0	Sampling Results	13
	Paugus Bay	13
	Runoff Outfalls Sampling Results	14
	Tributary Sampling Results	17
	Pickerel Cove Sampling Results	23
7.0	Discussion of Sampling Results	23
	General Water Quality Test	24
	Nutrients	24
	Petroleum Products	24
	Pickerel Cove Baseline Data	24
8.0	Conclusion	24
	Appendix A Sampling Procedures	
	Appendix B Sampling Locations	
	Appendix C Laboratory Analysis for Paugus Bay	
	Appendix D Laboratory Analysis for Runoff Outfalls	
	Appendix E Laboratory Analysis for Tributaries	
	Appendix F Laboratory Analysis for Pickerel Cove	

LIST OF FIGURES

Figure 3-1 Sampling Locations	4
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LIST OF TABLES

Table 1-1 Summary of Sampling Conducted by LWAC Summer 2001-2003	6
Table 4-1 Potential Sources of Non-Point Pollution Indicated by Analytical Tests	10
Table 5-1 Summary of Laconia Water Department's Test Results – 2002	11
Table 6-1 General Water Quality Paugus Bay Sampling Results	13
Table 6-2 Nutrient Load Paugus Bay Sampling Results	13
Table 6-3 Petroleum Products Paugus Bay Sampling Results	14

Table 6-4 General Water Quality Runoff Outfalls Sampling Results	15
Table 6-5 Nutrient Load Runoff Outfalls Sampling Results	16
Table 6-6 Petroleum Products Runoff Outfalls Sampling Results	17
Table 6-7 General Water Quality Tributary Sampling Results	18
Table 6-8 Nutrient Load Tributary Sampling Results	20
Table 6-9 Petroleum Products Tributary Sampling Results	22
Table 6-10 Summary of Sampling Results Pickerel Cove.....	23
Table A-1 Analytical Methods for Water Sampling.....	5
Table B-1 Paugus Bay Sampling Locations	2
Table B-2 Runoff Outfall Sampling Locations.....	2
Table B-3 Tributary Sampling Locations	3
Table B-4 Pickerel Cove Sampling Locations.....	4

1.0 EXECUTIVE SUMMARY

Volunteers from the Laconia Watershed Advisory Committee (LWAC) collected water samples four times over the past three years (2001-2003) during storm events. Sampling focused on three general areas:

- Paugus Bay near the water works
- Runoff outfalls draining directly into the lake
- Tributaries that drain into Paugus Bay

The following table provides a summary of the sampling locations. To determine baseline data, LWAC added Pickerel Cove to the list of sampling locations during the summer of 2003.

SUMMARY OF SAMPLING LOCATIONS

Paugus Bay:

- Near water department's intake.
- Upstream from water department's intake.
- Halfway between the water department's intake and Weirs Bridge.

Runoff outfalls draining directly into the lake:

- Drainage from residential landscaped areas.
- Drainage from paved areas adjacent to gasoline stations.
- Drainage commercial paved surfaces.
- Continuous discharge.

Tributaries:

- Runoff from areas of potentially high fertilizer and pesticide applications.
- Runoff from residential landscaped areas.
- Comparison of water quality upstream and downstream of a detention pond that receives runoff from extensive residential landscaped areas.
- Runoff from the Paugus Bay State Forest (potentially a non-impacted area).
- Runoff from commercially paved surfaces.
- Discharge from former leaking gasoline tanks which have been cleaned up under a State plan

The sampling was initiated after recommendation from the study entitled *Planning Study for Weirs, Paugus Bay, Opechee Bay and Winnepesaukee River Watershed* (February 2000) prepared for the Laconia Planning Board. In general, LWAC wanted to determine if runoff discharging directly into Paugus Bay and tributaries of Paugus Bay are sources of water pollution to Paugus Bay. LWAC had the water tested for general water quality, including bacteria, pH, conductivity, and total suspended solids (TSS); nutrients, including total kjeldahl nitrogen (TKN), total phosphorus (TP), chloride, nitrates/nitrites, and sulfates; and petroleum products, including methyl tertiary butyl ether (MTBE), benzene, toluene, ethylbenzene, xylene (BTEX), total petroleum hydrocarbons (TPH), and naphthalene.

Table 1-1 summarizes the sampling conducted in Paugus Bay, in the runoff discharging directly into Paugus Bay, and in the tributaries of Paugus Bay. As indicated above, the tests were conducted in three general areas: general water quality test, nutrients, and petroleum products.

General Water Quality Test

High bacteria levels indicate human or animal contamination. The bacteria counts in runoff outfalls were highest uphill from a commercial use (marina), from paved areas at commercial properties (retail store and fast food restaurant) and a roadway, and from residential landscaped areas. High bacteria levels require more chlorination at water works with the potential for higher levels of chlorination by-products (e.g., total trihalomethane, chloroform, dibromochloromethane, and bromodichloromethane)

Nutrients

High nutrient levels confirm that non-point pollution (stormwater runoff) is a major concern. Excessive nutrient levels will promote algae growth in the water bodies. The highest sampled TKN levels were in runoff potentially originating in residential landscaped areas. The highest total phosphorus levels were in tributaries near a parking lot adjacent to a former gas station with a remediated leading underground storage tank and near a commercial property (marina). The highest chloride levels were upstream in Singing Cove.

Petroleum Products

Data indicates that the MTBE in Paugus Bay is not from stormwater runoff. The University of New Hampshire study confirmed that recreational boating does raise the level of MTBE and other petroleum products in Paugus Bay.

TABLE 1-1
SUMMARY OF SAMPLING CONDUCTED BY LWAC
SUMMER 2001-2003

	Paugus Bay	Runoff Outfalls	Tributaries
General Water Quality			
Bacteria (CTS/100mL)	< 10	ND- 7900	<10- 2000+
pH	6.2-6.4	5-7	5-6.8
Conductivity (µmho)	63-69	24- 414	83- 277
Total Suspended Solids (mg/L)	-	ND- 43	1-19
Nutrients			
Total Kjeldahl Nitrogen (mg/L)	0.1-0.3	0.3- 2.18	0.2- 1.3
Total Phosphorus (mg/L)	0.003-0.007	0.022- 2.37	<0.005- 3.43
Chloride (mg/L)	11-13	2.6- 98	9.9- 1370
Nitrate/nitrite	-	<0.05-0.9	<0.05-0.9
Sulfate (mg/L)	4	2.8-9.7	5.7- 14
Petroleum Products			
MtBE (ug/L)	5-6	-	-
BTEX (ug/L)	ND-2	-	-
Naphthalene (ug/L)	-	-	-
TPH (ug/L)	-	-	-

Notes:

Bold indicates results are significantly higher than the Paugus Bay samples

ND = not detected

- below detection levels

CTS/100ml indicates bacteria counts per 100 milliliters

mg/L = milligrams per liter

µg/l = micrograms per liter

ppm = parts per million

In summary, although only a few samples were taken over several years, the data indicates that non-point pollution is present in the runoff discharging directly into Paugus Bay and in the tributaries discharging into Paugus Bay. This analysis has limitations since volunteers were conducting the sampling. In addition, sampling during rain events was virtually impossible in 2002 because of the drought. Finally, because of the lack of numerous samples, the data is inadequate to make major scientific conclusions. Thus, additional sampling is necessary.

Nonetheless, the sampling does indicate that Laconia needs to educate residents about the use of fertilizers and other contaminants that can drain into the lake in runoff and also needs to treat runoff from paved areas to reduce the potential for excess nutrients flowing into Paugus Bay.

2.0 INTRODUCTION

The Laconia Watershed Advisory Committee (LWAC), a subcommittee of the Laconia Planning Board, conducted sampling to characterize potential sources of non-point pollution to Paugus Bay, Lake Winnepesaukee. Pollution that emanates from a large area (e.g., a parking lot) as opposed from a distinct source (e.g., discharge pipe from an industrial process) is commonly referred to as “non-point” pollution. Non-point pollution to Paugus Bay could occur from storm water drains, streams (tributaries) and sheet flow over land. The purpose of this effort was to develop baseline data to support efforts to protect Paugus Bay’s water quality, the source of Laconia’s municipal drinking water and a recreation area for the City. Sampling was conducted of surface water in Paugus Bay itself, tributaries that feed Paugus Bay, and storm water out falls that empty into Paugus Bay.

3.0 BACKGROUND

In 1999, the City of Laconia conducted a study of the watershed surrounding its water supply intake located in Paugus Bay, Lake Winnepesaukee. The study was mandated by its 1991 Master Plan, which called for evaluation of the sensitivity of the watershed to development. The Watershed Study was conducted by Lobdell Associates, Inc. (Lobdell) and covered the drainage areas for Paugus Bay and Lake Opechee (*Planning Study for Weirs, Paugus Bay, Opechee Bay and Winnepesaukee River Watersheds* February 2000). The watershed, which is all the water that drains from the highest points around Paugus Bay down into the Bay is 6,230 acres, 1,234 acres of which are the bay itself.

An advisory committee consisting of the public-at-large; and representatives of the Planning Board, Conservation Commission, Water Works, and Public Works was established to provide input on the work (Watershed Advisory Committee). The purpose of the study was to develop recommendations to protect Laconia’s water supply.

Lobdell conducted the following analyses as part of the Watershed Study:

- Identification of pollution sources and their potential threats,
- Characterization of existing land use,
- Characterization of existing land capability to support development,
- Analysis of build out potential, and
- Paugus Bay carrying capacity.

The Watershed Study identified non-point pollution as the greatest pollution threat to Laconia’s water supply. The primary non-point pollution sources were:

- Urban storm runoff from a high percentage of pavement in commercial areas along Paugus Bay’s shoreline,
- Highway maintenance activities,
- Potential leaks from Underground Storage Tanks (USTs),

- Recreational activities on and immediately surrounding Paugus Bay, and
- Pesticide/herbicide use in developed areas and golf courses located adjacent to Paugus Bay.

The Watershed Study made recommendations that would maintain and improve water quality within the study area including:

- Public outreach and education;
- Incorporating best management practices into control of storm water runoff, and
- Collection of water quality data to better characterize potential threats to the water supply.

The Planning Board expanded the role of the Watershed Advisory Committee to implement the recommendations of the Watershed Study including the water quality sampling described in this report.

4.0 SAMPLING PLAN AND RATIONALE

Four sampling events were conducted:

- August 8, 2001 Paugus Bay samples
- September 4, 2001 Stormwater samples during a weak rain event
- July 31, 2002 Background (i.e., tributaries and standing water) samples during dry weather
- June 1, 2003 Stormwater samples during a strong rain event

A second stormwater sampling event, previously planned for 2002, did not occur due to a regional drought. Based on recommendations from the New Hampshire Department of Environmental Services, LWAC decided to collect background samples from tributaries and standing water where ever possible. A second round of stormwater sampling was conducted in 2003. Thus, the range of analytical results from the two stormwater sampling rounds are compared against the background data in the results section.

A quality assurance project plan (QAPP) was prepared in accordance with EPA guidelines, and was reviewed and approved by EPA. The quality assurance project plan identified sampling procedures, analytical methods, and all quality control requirements needed to ensure accurate and representative data is obtained. A copy of the quality assurance plan is on file with the Planning Department and is available on request. A summary of the sampling procedures and analytical methods is provided in Appendix A.

Samples were collected from Paugus Bay and from sources of water to Paugus Bay, namely runoff outfalls draining directly into the lake and tributaries (see Figure 3-1). A summary of all sample locations and sample numbers is shown in Appendix B. Paugus Bay samples were selected to characterize water quality near the inlet of the drinking water intake pipe and

upstream of the intake. Storm water outfall tributary samples were collected to characterize storm water runoff from potential sources of non-point pollution as summarized below.

Paugus Bay

- Near water department's intake.
- Upstream from water department's intake.
- Halfway between the water department's intake and Weirs Bridge.

Runoff Outfalls Draining Directly Into Lake:

- 6 locations drain residential landscaped areas.
- 2 locations drain paved areas adjacent to gasoline stations.
- 3 locations drain commercial paved surfaces.
- 1 location is from an outfall that has continuous discharge.

Tributaries:

- 2 locations receive runoff from areas of potentially high fertilizer and pesticide applications.
- 7 locations receive runoff from residential landscaped areas.
- 1 location pair compares water quality upstream and downstream of a detention pond that receives runoff from extensive residential landscaped areas.
- 1 location receives runoff from the Paugus Bay State Forest (potentially a non-impacted area).
- 4 locations receive runoff from commercially paved surfaces.
- 1 location receives runoff from is near a hazardous waste area (ERIKA????).

Pickerel Cove:

- 6 locations

As shown in Table 4-1, samples were analyzed for various parameters. Table 4-1 lists the potential sources of non-point pollution that may be indicated by the analytical test conducted.

TABLE 4-1
POTENTIAL SOURCES OF NON-POINT POLLUTION
INDICATED BY ANALYTICAL TESTS

Analytical Test		Rationale
GENERAL WATER QUALITY TEST		
Bacteria	E. coli	Excessive levels can indicate human and animal fecal matter
pH		pH of non-impact surface waters should range from 5.5 to 6.5.. The presence of many pollutants can impact ph.
Conductivity		High values may indicate excess levels of nutrients, salts, and/or metals.
Total Suspended Solids	TSS	High levels of sediment can impair water clarity, impact plant and animal life, and add excess nutrients. Non-treated runoff from roads and parking lots can cause excess levels of TSS to enter surface water
NUTRIENTS		
Total Kjeldahl Nitrogen	TKN	Excessive levels can indicate the presence of fertilizers, herbicides, and/or pesticides running off from lawns and landscaped areas into surface water
Total Phosphorus	TP	Excessive levels promote algal growth. Phosphorus is found in detergents, fertilizers, decay of plant material, and sediments.
Chloride	Cl	Excess levels can indicate the presence of salts from road salt or such things as fertilizers
Nitrate/nitrite		Excessive levels can indicate the presence of fertilizers, herbicides, and/or pesticides.
Sulfate		
PETROLEUM		
Methyl tertiary butylether	MTBE	This compound is an additive to gasoline that has been detected as a contaminant of water resources throughout New England
Benzene, toluene, ethylbenzene, xylene	BTEX	These compounds are components of gasoline. Their presence could indicate a leaking underground storage tank or excess runoff from filling and repair activities at a gas station.
Total Petroleum hydrocarbons	TPH	Petroleum hydrocarbons provide a indication of a variety of non-gasoline petroleum products such as lubricants, heating oils, diesel fuel, etc.
Naphthalene		A component of petroleum hydrocarbons often used to detect petroleum products heavier than gasoline most commonly heating oil and diesel fuel

5.0 SUMMARY OF OTHER SAMPLING

Laconia Water Department

In the Spring of 2003, Laconia Water Department sent a brochure, entitled *Our Daily Water!*, to Laconia water consumers. The annual report explained the water quality status of Laconia's drinking water. For 2002, Laconia's drinking water met or exceeded New Hampshire Department of Environmental Services and the U.S. Environmental Protection Agencies standards. Table 5-1 summarizes the drinking water testing results conducted by the Laconia Water Department in 2000.

TABLE 5-1
SUMMARY OF LACONIA WATER DEPARTMENT'S
TEST RESULTS – 2002

Contaminant	Level Detected	MCL	Potential Source Contamination
Microbiological Contaminants			
Total Coliform	0	0	
E. coli	0	0	
Turbidity	0.10 NTU	0.5 NTU	Stormwater runoff, especially with soil
Volatile Contaminants			
MTBE	Low = BDL High = 2.4 ug/L Average = 1.5 ug/L	13 ug/L	Boats and personal watercraft use and refueling
Total Trihalomethane	Low = 33 ug/L High = 82 ug/L Average = 52 ug/L	80 ug/L	By-product of drinking water chlorination
Total Organic Compounds	Low = 1.3 ppm High = 2.5 ppm Average = 1.77 ppm	TT	By-product of drinking water chlorination and naturally present in the environment
Haloacetic Acids	Low = 22 ug/L High = 29 ug/L Average = 25 ug/L	60ug/L	By-product of drinking water disinfection
Chloroform	26 ug/L	NA	By-product of drinking water chlorination
Dibromochloromethane	0.6 ug/L	NA	By-product of drinking water chlorination
Bromodichloromethane	5 ug/L	NA	By-product of drinking water chlorination
Inorganic Contaminants			
Lead	Average = 0.007 mg/L	0.015 mg/L	Stormwater runoff, especially erosion of natural deposits
Copper	Average = 0.057 mg/L	1.3 mg/L	Corrosion of household plumbing
Nitrate	<0.05 ppm	10 ppm	Stormwater runoff, especially with fertilizer and erosion of natural deposits; leachate from septic tanks, and sewage
Nitrite	<0.05 ppm	1 ppm	Stormwater runoff, especially with fertilizer and erosion of natural deposits; leachate from septic tanks, and sewage

MCL: Maximum Contaminant Level. The highest level of a contaminant that is allowed in drinking water. MCLs ensure that drinking water does not pose either a short-term or long-term health risk. MCLs are set at levels that are economically and technologically feasible.

MTBE: methyl tertiary butyl ether, a gasoline additive used to curb air pollution. It helps reduce air pollution, but it creates water pollution.

TT: Treatment technique, or a required process intended to reduce the contaminant level in drinking water.

NTU: Nephelometric Turbidity Unit

BDL: Below detection levels

ug/L: Micrograms per liter

ppm: Parts per million

mg/L: milligrams per liter

NA: Not applicable

Distribution of MtBE on Paugus Bay, NH July 1, 2003 Revised July 16, 2003 by Nancy E. Kinner, Thomas P. Ballestero, and Michelle Mills, University of New Hampshire

The conclusions of the report were:

- The MtBE concentrations in Paugus Bay during 2002 did not approach the critical 13 µg/L Maximum Contaminant Level (MCL). Provided that the sale of low MtBE gasoline continues, it is likely that the MCL will not be exceeded in the Laconia water supply, unless there is an increase in motorized vessel activity.
- Lake Winnepesaukee provides a constant and significant input of MtBE into Paugus Bay during the spring and summer.
- The input of MtBE from motorized vessels operating in Paugus Bay is significant during the late spring and summer. This impact is compounded by the thermal stratification of the Bay, which decreases the volume of water in which the MtBE released can be diluted.
- Inputs of MtBE from other sources such as storm water discharge and atmospheric precipitation are insignificant. It is likely that unless a spill or leak occurs, the inputs from surface runoff and groundwater discharge will also be minimal.
- There are areas in Paugus Bay (e.g., Langley Cove) that do not circulate as readily as the main channel and experience higher levels of MtBE.
- The processes used in the Laconia Water Treatment Plant do not remove MtBE from the water.
- Continued monitoring of MtBE is recommended.
- Continued sale of low MtBE gas at marinas (a number of marinas instituted this practice voluntarily last summer) is recommended.
- Recommends practices that will reduce idling of engines.
- Though study did not focus on other constituents of gasoline, study indicates that discharge of gas that contains MtBE is also discharging other petroleum pollution.

6.0 SAMPLING RESULTS

This section provides a summary of the sampling results for Paugus Bay, runoff outfalls draining directly into the lake, tributaries, and Pickerel Cove. The detailed lab analyses are provided in Appendices C to F.

Paugus Bay

Sampling in Paugus Bay was conducted on August 8, 2001. Sampling was conducted at four locations with a duplicate sample taken at one location. Appendix C contains the lab analysis results.

**TABLE 6-1
GENERAL WATER QUALITY
PAUGUS BAY SAMPLING RESULTS**

Sample #	E. coli cts. CTS/100mL	pH	Conductivity µmho	TSS mg/L
BAY-025	<10	6.26	208	-
BAY-026	<10	6.33	63	-
BAY-027 (Duplicate)	<10	6.39	69	-
BAY-028	<10	6.42	63	-
BAY-029	<10	6.45	68	-

Notes:

“-“ indicates not detected above method detection limits
CTS/100ml indicates bacteria counts per 100 milliliters
mg/L indicates milligrams per liter

**TABLE 6-2
NUTRIENT TESTS
PAUGUS BAY SAMPLING RESULTS**

Sample #	TKN mg/L	TP mg/L	Chloride mg/L	Nitrate/Nitrite mg/L	Sulfate mg/L
BAY-025	.1	0.004	13	-	4
BAY-026	.2	0.003	12	-	4
BAY-027 (Duplicate)	.2	0.007	12	-	4
BAY-028	.3	0.004	11	-	4
BAY-029	.1	0.003	12	-	4.1

Notes:

“-“ indicates not detected above method detection limits
mg/L indicates milligrams per liter
TP indicates total phosphorus
TKN indicates total kjeldahl nitrogen

TABLE 6-3
PETROLEUM PRODUCTS
PAUGUS BAY SAMPLING RESULTS

Sample #	MTBE µg/L	BTEX µg/L	Naphthalene µg/L
BAY-025	5	-	-
BAY-026	5	-	-
BAY-027 (Duplicate)	5	-	-
BAY-028	6	2	-
BAY-029	6	-	-

Notes:

“-“ indicates not detected above method detection limits
BTEX indicates benzene, toluene, ethylbenzene, xylene
MTBE indicates methyl tertiary butyl ether
µg/l indicates micrograms per liter
ppm I indicates parts per million

Runoff Outfalls Sampling Results

Four sampling events were conducted:

- August 8, 2001 Paugus Bay samples (NOTE: results discussed in previous section)
- September 4, 2001 Stormwater samples during a weak rain event
- July 31, 2002 Background (i.e., tributaries and standing water) samples during dry weather
- June 1, 2003 Stormwater samples during a strong rain event

A second stormwater sampling event, previously planned for 2002, did not occur due to a regional drought. Based on recommendations from the New Hampshire Department of Environmental Services, LWAC decided to collect background samples from tributaries and standing water wherever possible. A second round of stormwater sampling was conducted in 2003. Thus, the range of analytical results from the 2001 and 2003 stormwater sampling rounds are compared against the 2002 background data in the following tables.

Appendix D contains the lab analysis results.

**TABLE 6-4
GENERAL WATER QUALITY
RUNOFF OUTFALLS SAMPLING RESULTS**

Sample #	Anticipated Source of Runoff	E. coli ⁽¹⁾ CTS/100mL	PH ⁽²⁾	Conductivity ⁽²⁾ µmho	TSS ⁽²⁾ mg/L
Southwest side of Paugus Bay					
OUT-001	Residential landscaped areas	() 1300 to >2000	6.41	383	11
OUT-002	Residential landscaped areas	(10) <10 to 20	7.29	271	-
OUT-003	Residential landscaped areas	(NS) NS to <5	NS	NS	NS
Northwest/North side of Paugus Bay					
OUT-004	Commercial use (marina) – paved areas	(NS) 20 to NS	5.02	114	43
OUT-011	Always flowing-collects storm water from properties uphill located on Endicott Street	(NS) <10 to NS	6.56	414	-
Northeast side of Paugus Bay					
OUT-006	Commercial use (convenience stores & motels) - paved areas	(>2000) 1110 to 1410	NT	NT	5
OUT-005	Commercial use (condominiums)- paved areas	(NS) >2000 to NS	5.70	24	-
Southeast side of Paugus Bay					
OUT-007	Commercial use (commercial store & roadway) - paved areas	(NS) 10 to 70	6.32	62	-
OUT-008	Commercial paved area (fast food parking lot) and residential landscaped areas.	(460) 1680 to >2000	NT	NT	-
OUT-009 (Duplicate of 008)	Commercial paved area (fast food parking lot) and residential landscaped areas.	(380) 1520 to >2000	6.65	151	5
OUT-010	Commercial use (marina)	(<100) <10 to <10	NT	NT	9
OUT-010 D	Duplicate of OUT-010	(<100) NS to <10	NS	NS	NS
OUT-010A	Upgradient of marina	(NS) NS to >900	NS	NS	NS
OUT-023	Commercial use – from parking lot	(NS) NS to 1800	NS	NS	NS

Notes:

(1) . (600) 1300-2000

The first number (**bold**) represents background data from the 2002 sampling event during dry weather. The range of numbers represents the results from the two stormwater sampling events.

(2) These parameters were only tested for in 2001 during a weak rain event.

“-“ indicates not detected above method detection limits
 NS indicates “not sampled”- sample wasn’t collected because of lack of flow
 NT indicates “no test result” - laboratory was not able to run test or test was invalid
 CTS/100ml indicates bacteria counts per 100 milliliters
 µMHO indicates micro
 mg/L indicates milligrams per liter

TABLE 6-5
NUTRIENT TESTS
RUNOFF OUTFALLS SAMPLING RESULTS

Sample #	Anticipated Source of Runoff	TKN ⁽¹⁾ mg/L	TP mg/L ⁽¹⁾	Chloride ⁽²⁾ mg/L	Nitrate/Nitrite ⁽²⁾ mg/L	Sulfate ⁽²⁾ mg/L
Southwest side of Paugus Bay						
OUT-001	Residential landscaped	(NS) 0.7 to 2.18	(NS) .093 to .135	97	0.8	13
OUT-002	Residential landscaped areas	(<0.05) 0.5 to 0.8	(0.017) 0.007 – 0.022	59	BDL - <0.05	6.3
OUT-003	Residential landscaped areas	(NS) NS to <0.05	(NS) NS to 0.041	NS	NS	NS
Northwest/North side of Paugus Bay						
OUT-004	Commercial use (marina) – paved areas	(NS) 0.6 to NS	(NS) 0.214 to NS	23	0.6	9.7
OUT-011	Always flowing-collects storm water from properties uphill located on Endicott Street	(NS) 0.1 to NS	(NS) 0.051 to NS	98	0.5	9.7
Northeast side of Paugus Bay						
OUT-006	Commercial use (convenience stores & motels) – paved areas	(0.29) 0.8 to 0.13	(1.37) 0.034 to 0.112	21	0.5	9.7
OUT-005	Commercial use (condominiums)- paved areas	(NS) 0.4 to NS	(NS) 0.086 to NS	2.6	0.4	2.8
Southeast side of Paugus Bay						
OUT-007	Commercial use (commercial store & roadway) – paved areas	(NS) <0.05 to 0.3	(NS) 0.008 to 0.026	9.5	0.3	5.7
OUT-008	Commercial paved area (fast food parking lot) and residential landscaped areas.	(0.36) 0.18 to 0.3	(0.037) 0.053 to 0.065	30	0.18 – 0.7	11
OUT-009 (Duplicate of 008)	Same	(0.33) 0.19 to 0.5	(0.041) 0.065 to 0.07	29	0.19 – 0.7	11
OUT-010	Commercial use (marina)	(<0.05) 0.4 to 0.5	(2.37) 0.156 to 0.174	2.6	<0.05 - .05	NT
OUT-010 D	Duplicate of OUT-010	(<0.05) NS to 0.51	(0.319) NS to 0.152	NS	NS	NS
OUT-010A	Upgradient of marina	(NS) NS to 1.82	(NS) NS to 0.137	NS	NS	NS
OUT-023	Commercial use – from parking lot	(NS) NS to 0.51	(NS) NS to 0.126	NS	NS	NS

Notes:

(1) . (600) 1300-2000

The first number (**bold**) represents background data from the 2002 sampling event during dry weather. The range of numbers represents the results from the two stormwater sampling events.

(2) These parameters were only tested for in 2001 during a weak rain event.

NS indicates “not sampled” - sample wasn’t collected because of lack of flow
 NT indicates “no test result” - laboratory was not able to run test or test was invalid
 mg/L indicates milligrams per liter
 TP indicates total phosphorus
 TKN indicates total kjeldahl nitrogen
 BLD indicates below detection levels

TABLE 6-6
PETROLEUM PRODUCTS
RUNOFF OUTFALLS SAMPLING RESULTS

Sample #	Anticipated Source of Runoff	MTBE µg/L	BTEX µg/L	Naphthalene µg/L	TPH ppm
Southwest side of Paugus Bay					
OUT-001	Residential landscaped areas	-	-	-	NT
OUT-002	Residential landscaped areas	-	-	-	NT
OUT-003	Residential landscaped areas	NS	NS	NS	NS
Northwest/North side of Paugus Bay					
OUT-004	Commercial use (marina) – paved areas	-	-	-	-
OUT-011	Always flowing-collects storm water from properties uphill located on Endicott Street	-	-	-	-
Northeast side of Paugus Bay					
OUT-006	Commercial use (convenience stores & motels) - paved areas	-	-	-	-
OUT-005	Commercial use (condominiums)- paved areas	-	-	-	NT
Southeast side of Paugus Bay					
OUT-007	Commercial use (commercial store & roadway) - paved areas	-	-	-	NT
OUT-008	Commercial paved area (fast food parking lot) and residential landscaped areas.	-	-	-	NT
OUT-009 (Duplicate of 008)	Same	-	-	-	NT
OUT-010	Commercial use (marina)	-	-	-	-

Notes:

These analytical parameters were only tested for in the 2001 sampling round during a weak storm event.

“-“ indicates not detected above method detection limits
 NS indicates “not sampled”- sample wasn’t collected because of lack of flow
 NT indicates “no test result” - laboratory was not able to run test or test was invalid
 BTEX indicates benzene, toluene, ethylbenzene, xylene
 MTBE indicates methyl tertiary butyl ether
 TPH indicates total petroleum hydrocarbons
 µg/l indicates micrograms per liter
 ppm indicates parts per million

Tributary Sampling Results

Sampling was conducted on September 4, 2001 and June 1, 2003. Appendix E contains the lab analysis results.

**TABLE 6-7
GENERAL WATER QUALITY
TRIBUTARY SAMPLING RESULTS**

Sample #	Anticipated Source of Runoff	E. coli ⁽¹⁾ CTS/100mL	PH ⁽²⁾	Conductivity ⁽²⁾ µmho	TSS ⁽²⁾ mg/L
West side of Paugus Bay					
TRIB-011	Fertilizer and pesticide runoff from upland areas	(NS) NS to <10	NS	NS	NS
TRIB-011A	Upland areas – adjacent to golf course	(NS) NS to 10	NS	NS	NS
TRIB-012	Fertilizer and pesticide runoff from upland areas	(NS) <10 to >2000	6.03	104	46
TRIB-012A	Upland areas – adjacent to golf course	(NS) NS to 1200	NS	NS	NS
TRIB-013	Residential landscaped areas	(160) 10 to >2000	6.37	83	13
TRIB-013 A	Residential landscaped areas	(50) NS to 10			
TRIB-014	Anticipate that non-point pollution would be reduced in comparison with TRIB-013 due to presence of detention pond	(10) <10 to >2000	6.89	139	7
Northwest side of Paugus Bay					
TRIB-015	Residential landscaped areas	(NS) NS to NS	NS	NS	NS
TRIB-016	Runoff from forested area – may be representative of un-impacted runoff	(90) NS to NS	NS	NS	NS
TRB –017	???				
TRIB-017A (Duplicate)	Same	(80) NS to <10	NS	NS	NS
TRIB-018	Residential landscaped areas	(80) 20 to 230	6.55	175	14
TRIB-018A (duplicate)	Same	(40) NS to <10	NS	NS	NS
TRIB-019	Anticipate that non-point pollution would be reduced in comparison with TRIB-018 due to presence of cove acting as a detention pond	(NS) 10 to NS	6.82	75	NT
East side of Paugus Bay					
TRIB-24	Residential landscaped areas and roadway	(10) 280 to >2000	NT	NT	NT
TRIB-005	Parking lot of large condominium complex	(NS) NS to 20	NS	NS	NS
Southeast side of Paugus Bay					
TRIB-20	Residential landscaped areas and commercial areas (restaurants & motels) -paved surfaces	(60) 10 to 30	5.94	68	-
TRIB-21	Outlet at southern portion of Gilford Plaza parking lot - adjacent to a remediated leaking underground gasoline tank site (former gas station) as well as commercial (plaza parking lot) paved surfaces	(<100) 570 to >2000	6.51	215	11
TRIB-22	Commercial use (fast food and commercial stores) paved surfaces	(<100) 350 to 1160	6.52	277	1
TRIB-23	Commercial use (fast food & restaurants and small stores) - paved surfaces	(10) >2000 to NS	5.01	126	19
TRIB-25	Blank	(<10) NS to <5	NS	NS	NS
TRIB-25A	Blank	(<5) NS to NS	NS	NS	NS
TRIB-26	Blank	(NS) NS to <10	NS	NS	NS

Notes:

- (1) . **(600)** 1300-2000

The first number (**bold**) represents background data from the 2002 sampling event during dry weather. The range of numbers represents the results from the two stormwater sampling events.

- (2) These parameters were only tested for in 2001 during a weak rain event.

“-“	indicates not detected above method detection limits
NS	indicates “not sampled”- sample was not collected because of lack of flow
NT	indicates “no test result” - laboratory was not able to run test or test was invalid
CTS/100ml	indicates bacteria counts per 100 milliliters
mg/L	indicates milligrams per liter

**TABLE 6-8
NUTRIENT TESTS
TRIBUTARY SAMPLING RESULTS**

Sample #	Anticipated Source of Runoff	TKN ⁽¹⁾ mg/L	TP ⁽¹⁾ mg/L	Chloride ⁽²⁾ mg/L	Nitrate/Nitrite ⁽²⁾ mg/L	Sulfate ⁽²⁾ mg/L
West side of Paugus Bay						
TRIB-011	Fertilizer and pesticide runoff from upland areas	(NS) NS to 0.05	(NS) NS to 0.031	NS	NS	NS
TRIB-011A	Upland areas – adjacent to golf course	(NS) NS to 0.11	(NS) NS to 0.062	NS	NS	NS
TRIB-012	Fertilizer and pesticide runoff from upland areas	(NS) <0.05 to 0.6	(NS) <0.027 to 0.294	20	.3	9.5
TRIB-012A	Upland areas – adjacent to golf course	(NS) NS to 0.06	(NS) NS to 0.057	NS	NS	NS
TRIB-013	Residential landscaped areas	(0.58) 0.14 to 1.3	(0.025) 0.01 to 0.227	9.9	. 0.14 – 0.8	8.7
TRIB-013A	Residential landscaped areas	(0.07) NS to 0.17	(0.014) NS to 0.008	NS	NS	NS
TRIB-014	Anticipate that non-point pollution would be reduced in comparison with TRIB-013 due to presence of detention pond	(<0.05) 0.25 to 0.7	(0.021) 0.01 to 0.072	16	.<0.05 – 0.3	14
Northwest side of Paugus Bay						
TRIB-015	Residential landscaped areas	(NS) NS to NS	(NS) NS to NS	NS	NS	NS
TRIB-016	Runoff from forested area – may be representative of un-impacted runoff	(0.05) NS to NS	(0.021) NS to NS	NS	NS	NS
TRIB-017	????	(NS) NS to 0.05	(NS) NS to 0.007	NS	NS	NS
TRIB-017A (Duplicate)	Same	(0.18) NS to NS	(0.02) NS to NS	1370	NS	NS
TRIB-018	Residential landscaped areas	(0.05) <0.05 to 0.8	(0.027) 0.016 to 0.058	38	BDL - <0.05	5.7
TRIB-018A (Duplicate)	Same	(0.17) NS to <0.05	(0.03) NS to 0.007	NS	NS	NS
TRIB-019	Anticipate that non-point pollution would be reduced in comparison with TRIB-018 due to presence of cove acting as a detention pond	(NS) 0.2 to NS	(NS) .007 to NS	NT	NT	NT
East side of Paugus Bay						
TRIB-24	Residential landscaped areas and roadway	(NS) 0.7 to NS	(NS) 0.114 to NS	11	.6	NT
TRIB-005	Parking lot of large condominium complex	(NS) NS to 0.56	(NS) NS to 0.089	NS	NS	NS
Southeast side of Paugus Bay						
TRIB-20	Residential landscaped areas and commercial areas (restaurants & motels) -paved surfaces	(0.89) 0.5 to 0.25	(0.089) 0.027to 0.029	8.5	0.25 – 0.89	9.8
TRIB-21	Outlet at southern portion of Gilford Plaza parking lot - adjacent to a remediated leaking underground gasoline tank site (former gas station) as well as commercial (plaza parking	(0.24) 0.5 to 0.35	(3.43) 0.054 to 0.054	52	0.24 – 0.4	6.9

	lot) paved surfaces					
TRIB-22	Commercial use (fast food and commercial stores) paved surfaces	(0.05) 0.5 to 0.08	(0.111) 0.03 to 0.04	66	BDL – 0.08	7.1
TRIB-23	Commercial use (fast food & restaurants and small stores) -paved surfaces	(0.09) 0.5 to NS	(0.08) 0.097 to NS	24	0.09 – 0.4	13
TRIB-25	Blank	(< 0.05) NS to <0.5	(< 0.005) NS to <0.005	NS	NS	NS
TRIB-26	Blank	(NS) NS to <0.05	(NS) NS to <0.005	NS	NS	NS

Notes:

- (1) . (**600**) 1300-2000

The first number (**bold**) represents background data from the 2002 sampling event during dry weather. The range of numbers represents the results from the two stormwater sampling events.

- (2) These parameters were only tested for in 2001 during a weak rain event.

“_“ indicates not detected above method detection limits
 NS indicates “not sampled”- sample wasn’t collected because of lack of flow
 NT indicates “no test result” - laboratory was not able to run test or test was invalid
 mg/L indicates milligrams per liter
 TP indicates total phosphorus
 TKN indicates total kjeldahl nitrogen
 BDL indicates below detection levels

TABLE 6-9
PETROLEUM PRODUCTS
TRIBUTARY SAMPLING RESULTS

Sample #	Anticipated Source of Runoff	MTBE µg/L	BTEX µg/L	Naphthalene µg/L	TPH ppm
West side of Paugus Bay					
TRIB-011	Fertilizer and pesticide runoff from upland areas	NS	NS	NS	NS
TRIB-012	Fertilizer and pesticide runoff from upland areas	-	-	-	NT
TRIB-013	Residential landscaped areas	-	-	-	NT
TRIB-014	Anticipate that non-point pollution would be reduced in comparison with TRIB-013 due to presence of detention pond	-	-	-	NT
Northwest side of Paugus Bay					
TRIB-015	Residential landscaped areas	NS	NS	NS	NS
TRIB-016	Runoff from forested area – may be representative of un-impacted runoff	NS	NS	NS	NS
TRIB-017 (Duplicate)	Runoff from forested area – may be representative of un-impacted runoff	NS	NS	NS	NS
TRIB-018	Residential landscaped areas	-	-	-	NT
TRIB-019	Anticipate that non-point pollution would be reduced in comparison with TRIB-018 due to presence of cove acting as a detention pond	-	-	-	NT
East side of Paugus Bay					
TRIB-24	Residential landscaped areas and roadway	-	-	-	NT
Southeast side of Paugus Bay					
TRIB-20	Residential landscaped areas and commercial areas (restaurants & motels) -paved surfaces	-	-	-	NT
TRIB-21	Outlet at southern portion of Gilford Plaza parking lot - adjacent to a remediated leaking underground gasoline tank site (former gas station) as well as commercial (plaza parking lot) paved surfaces	-	-	-	-
TRIB-23	Commercial use (fast food & restaurants and small stores) -paved surfaces	-	-	-	NT
TRIB-22	Commercial use (fast food and commercial stores) paved surfaces	-	-	-	NT

Notes:

Sampling for these compounds was only conducted during 2001 sampling event.

“-“ indicates not detected above method detection limits
 NS indicates “not sampled”- sample wasn’t collected because of lack of flow
 NT indicates “no test result” - laboratory was not able to run test or test was invalid
 BTEX indicates benzene, toluene, ethylbenzene, xylene
 MTBE indicates methyl tertiary butyl ether
 TPH indicates total petroleum hydrocarbons
 µg/l indicates micrograms per liter
 ppm indicates parts per million

Pickerel Cove Sampling Results

On May 19, 2003, sampling was conducted at Pickerel Cove to establish baseline levels before major construction commences upstream. Pickerel Cove was sampled for the following compounds:

- Volatile organic chemicals
- Inorganic chemicals, including metals
- PAHs

Most of the compounds sampled were below detection levels except for those indicated in Table 6-10. The detailed lab analyses are contained in Appendix F.

**TABLE 6-10
SUMMARY OF SAMPLING RESULTS
PICKEREL COVE**

Pickerel Cove Location	Barium (mg/L)	Nitrates/Nitrites (mg/L)	Total Phosphorus (mg/L)
PC1	0.0103	-	0.016
PC2	0.0107	-	0.023
PC3	0.005	0.46	0.009
PC4	0.0104	-	0.034
PC5	0.0129	-	0.017
PC6	0.0197	-	0.016

7.0 DISCUSSION OF SAMPLING RESULTS

As indicated in the results section under the anticipated runoff section of the tables, the sources of pollution vary depending upon the location. Potential sources of runoff are paved roads and parking lots and commercial and residential properties. Other possible sources of pollution include fertilizers, herbicides, and pesticides from lawns, golf courses, and landscaped areas. The sampling was conducted to provide data on the type of pollutants in Paugus Bay, its tributaries, and the runoff discharging directly into Paugus Bay. Various runoff and tributary locations were sampled to give an indication of the magnitude that certain activities contribute to Paugus Bay water pollution. The remainder of this section provides a brief discussion of the sampling results.

General Water Quality Test

High bacteria levels indicate human or animal contamination. The bacteria counts in runoff outfalls were highest uphill from a commercial use (marina), from paved areas at commercial properties (retail store and fast food restaurant) and a roadway, and from residential landscaped areas. High bacteria levels require more chlorination at water works with the potential for higher levels of chlorination by-products (e.g., total trihalomethane, chloroform, dibromochloromethane, and bromodichloromethane)

Nutrients

High nutrient levels confirm that non-point pollution (stormwater runoff) is a major concern. Excessive nutrient levels will promote algae growth in the water bodies. The highest sampled TKN levels were in runoff potentially originating in residential landscaped areas. The highest total phosphorus levels were in tributaries near a parking lot adjacent to a former gas station with a remediated leading underground storage tank and near a commercial property (marina). The highest chloride levels were upstream in Singing Cove.

Petroleum Products

Data indicates that the MTBE in Paugus Bay is not from stormwater runoff. The University of New Hampshire study confirmed that recreational boating does raise the level of MTBE and other petroleum products in Paugus Bay.

Pickrel Cove Baseline Data

Data indicates slight nutrient loadings (0.009 – 0.23mg/L of total phosphorus). Small amounts of barium were present probably from erosion of natural deposits. No PAHs or other organic chemicals were detected.

8.0 CONCLUSION

Although only a few samples were taken over several years, the data indicates that non-point pollution is present in the runoff discharging directly into Paugus Bay and in the tributaries discharging into Paugus Bay. This analysis has limitations since volunteers were conducting the sampling. In addition, sampling during rain events was virtually impossible in 2002 because of the drought. Finally, because of the lack of numerous samples, the data is inadequate to make major scientific conclusions. Thus, additional sampling is necessary.

Nonetheless, the sampling does indicate that Laconia needs to educate residents about the use of fertilizers and other contaminants that can drain into the lake in runoff and also needs to treat runoff from paved areas to reduce the potential for excess nutrients flowing into Paugus Bay.

Appendix A

Sampling Procedures

- A-1 Tributary and Runoff Outfall Sampling Procedure**
- A-2 Surface Water Sampling Procedure**
- A-3 Analytical Parameters and Methods**

A-1 Tributary and Runoff Outfall Sampling Procedure

Every attempt was made to total submerge sample bottles when collecting tributary samples. A note was made in the logbook if the water depth was too low to accommodate the largest sample bottle. Tributary samples were collected from downstream to upstream, reducing the likelihood of contaminating downstream samples. Samplers were collect in a manner to avoid disturbing bottom materials and entry of surface debris into sample bottles. If bottom materials or sediments were disturbed, samples were collected further upstream or nearby in a non-disturbed area.

Samples were placed on ice and stored in a cooler immediately after collection. Prior to shipment, additional ice was placed in coolers if necessary and samples were secured with packing materials to prevent breakage.

The following procedure was used to collect tributary and outfall.

1. Label all sample bottles with appropriate sample location numbers.
2. Record the following information in the logbook for each sample location:
 - Sample number
 - Time
 - Location description
 - GPS coordinates
 - Current weather conditions
 - Water temperature
 - Water depth
 - General observations of water conditions: clarity, odor, etc
 - Sample location sketch
3. Collect the Bacteria sample first in the following manner:
 - Remove the cap when ready to collect sample.
 - Avoid touching the neck, inside the bottle or cap to prevent contamination.
 - *Prime* the bottle by collecting approximately half a volume of water, shake for 5 seconds,
then pour water out.
 - Sample between the top and bottom of
flowing stream.
 - Point the mouth of the bottle towards the water surface, submerge completely and scoop the water in an upward “U-shaped” motion *away* from you.
4. Collect samples requiring preservative (TP/TKN and nitrate/nitrite):
 - Careful! Bottle contains acid preservative.
 - Do not prime bottle.
 - Do not overfill bottle or preservative will be lost.
 - Collect the sample using a non-preserved bottle and pour the collected water into the

Nitrate/Nitrite bottle and *TP/TKN* bottle.

- Collect sample water between the top and bottom of flowing stream.
- Point the mouth of the bottle towards the water surface, submerge completely and scoop the water in an upward “U-shaped” motion *away* from you.

5. Collect TPH and BTEX/MtBE/naphthalene samples

- Careful! Bottles contain hydrochloric acid preservative.
- Do not *prime* bottle.
- Do not overfill bottle or preservative will be lost.
- Collect the sample using a non-preserved bottle (1 Quart plastic), pour the collected water into the glass vials.
- Collect sample water between the top and bottom of flowing stream.
- Point the mouth of the bottle towards the water surface, submerge completely and scoop the water in an upward “U-shaped” motion *away* from you.
- Vials must be filled completely and capped quickly.
- Turn vial upside down and tap vigorously to check for trapped air bubbles.
- Samples with air bubbles must be discarded and recollected.

6. Collect reminder of nutrient samples (pH, conductivity, TSS, chloride, sulfate):

- *Prime* the bottle as described in step 3.
- Sample between the top and bottom of flowing stream.
- Point the mouth of the bottle towards the water surface, submerge completely and scoop the water in an upward “U-shaped” motion *away* from you.

7. Place all samples in an ice-filled cooler.

8. Fill in relevant information in logbook.

A-2 Surface Water Sampling Procedure

Paugus Bay samples were collected using the following procedure:

1. Label all sample bottles with appropriate sample location numbers.
2. Record information as asked in the log book.
3. All surface water samples will be obtained using a collecting bottle with a lid attached to a rod. The collecting bottle will be disinfected with a chlorine solution prior to sampling event. The collecting bottle will be primed before sampling at each sample location. It is not necessary to prime the collecting bottle prior to filling each sample bottle.
4. Collect the samples using the rod and bottle, lowering to a depth of 3 to 4 feet. Bring it up and pour into the sample bottle.
5. Collect the Bacteria sample first in the following way:
 - Remove the cap when ready to collect sample.

- Avoid touching the neck, inside the bottle or cap to prevent contamination.
 - *Prime* the bottle by collecting approximately half a volume of water, shake for 5 seconds, then pour water out.
6. Collect samples requiring preservative (TP/TKN and nitrate/nitrite):
 - Careful! Bottle contains acid preservative.
 - Do not *prime* bottle.
 - Do not overfill bottle or preservative will be lost.
 7. Collect TPH and BTEX/MtBE/naphthalene samples
 - Careful! Bottles contain hydrochloric acid preservative.
 - Do not *prime* bottle.
 - Do not overfill bottle or preservative will be lost.
 8. Collect remainder of nutrient samples (pH, conductivity, TSS, chloride, sulfate):
 - *Prime* the bottle as described in step 5.
 9. Place all samples in an ice-filled cooler.
 10. Take dissolved oxygen readings by lowering a D.O. probe 3 to 4 ft depth. Readings will be recorded in the logbook.
 11. Take water temperature by lowering a thermometer into the water to the 3 to 4 feet depth. Temperature readings will be recorded in the logbook.

A-3 Analytical Parameters and Methods

The following table presents the parameters sampled and analytical methods used to analyze the Paugus Bay, tributary, and runoff outfall samples.

TABLE A-1
ANALYTICAL METHODS FOR WATER SAMPLING

Sampling Parameters	Analytical Laboratory	Analytical Method
Total Phosphorus	DES	EPA 365.2 Lachat QuikChem Method 10-115-01-1-F
Bacteria -E coli	DES	SM 9213 D.3
TKN	DES	EPA 351.2
Turbidity	DES/Limnology lab	
pH	Aquarian Analytical (AA)	SM 4500-H B
Conductivity	AA	SM 2510 B
Total Suspended Solids	AA	SM 2450 D
Combined Nitrate/nitrite	AA	EPA 300
Chloride	AA	EPA 300
Sulfate	AA	EPA 300
Total Petroleum Hydrocarbons (TPH)	AA	8100 (1 ppm detection limit)
BTEX & MTBE & Naphthalene	AA	8260

Note:

SM –Standard Methods for the Examination of Water & Wastewater, 19th Edition, 1995

EPA- EPA Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020,1979, rev. March 1983

DES laboratory is located at 6 Hazen Drive, Concord, NH

Aquarian Analytical is located in Canterbury, NH immediately off Exit 19 (I93)

Appendix B

Sampling Locations

TABLE B-1
PAUGUS BAY SAMPLING LOCATIONS

Sample #	Location	Rationale
BAY-025	Downstream of intake	Overall Paugus Bay water quality
BAY-026	Laconia Water Works intake	Drinking water quality
BAY-027	Laconia Water Works intake Duplicate	Drinking water quality
BAY-028	Upstream of LWW intake – The Weirs	Quality of water entering from Lake Winnepesaukee
BAY-029	Upstream of LWW intake – between the Weirs and LWW	General water quality

Runoff Outfall samples are listed beginning with the southwest corner of Paugus Bay and going around Paugus Bay from southwest, to northwest, to north, to northeast, and lastly to the east until the last sampling location at S1-OUT-010.

TABLE B-2
RUNOFF OUTFALL SAMPLING LOCATIONS

Sample #	Area of Paugus Bay	Location	Anticipated Source of Runoff
OUT-001	Southwest side	Storm drain located at the end of Massachusetts Avenue	Residential landscaped areas
OUT-002	Southwest side	Storm drain located in a detention pond	Residential landscaped areas
OUT-003	Southwest side	Storm drain located on a residents property	Residential landscaped areas
OUT-004	Northwest side	Pool of water above storm drain located just south of Weirs Bridge	Commercial use (marina) – paved areas
OUT-011	Northern most point	Underneath Weirs Bridge	Always flowing-collects storm water from properties uphill located on Endicott Street
OUT-006	Northeast side	Storm drain located just south of Wiers (approx. 1/8 mile) off Wiers Boulevard.	Commercial use (convenience stores & motels) - paved areas
OUT-005	Northeast side	Storm drain located along Wiers Boulevard approximately (MILES?) south from the Weirs.	Commercial use (condominiums)- paved areas
OUT-007	Southeast side	Storm drain located off Wiers Boulevard ??? miles south of Wiers	Commercial use (commercial store & roadway) - paved areas
OUT-008	Southeast side	Storm drain located off Union Avenue approx. ¼ mile north of Laconia Water Works.	Commercial paved area (fast food parking lot) and residential landscaped areas.
OUT-009 (DUPLICATE of 008)	Same	Same	Same
OUT-010	Southeast side	Storm drain located off Union Avenue just south of Laconia Water Works.	Commercial use (marina)
OUT-010A	Southeast side	Storm drain located upgradient of out-010 alongside Union Ave in Hurt & Forbes parking lot	Upgradient stormwater into 010
OUT-023	Southeast side	Storm drain outlet from parking lot (storm drain located adjacent to Paugus Dinner)	Commercial use

Tributary samples are listed beginning with the southwest corner of Paugus Bay and going around Paugus Bay from southwest, to northwest, to north, to northeast, and lastly to the east until the last sampling location at TRIB-011.

TABLE B-3
TRIBUTARY SAMPLING LOCATIONS

Sample #	Area of Paugus Bay	Location	Anticipated Source of Rationale
TRIB-005	West Side	Stormdrain	
TRIB-011	West side	Stream discharging through a pipe adjacent to railroad tracks near intersection of North Street and Paugus Park Road	Fertilizer and pesticide runoff from upland areas
TRIB-011A	West side	Collected from stream running adjacent to fairway of golf course.	Fertilizer and pesticide runoff from upland areas used for golf course
TRIB-012	West side	Drainage ditch adjacent to railroad track approx. (Miles??) north on Paugus Park Road	Fertilizer and pesticide runoff from upland areas
TRIB-012A	West side	Collected from stream running adjacent to fairway of golf course.	Fertilizer and pesticide runoff from upland areas used for golf course
TRIB-O13	West side	Sample location is downstream end of culvert which drains tributary that crosses Outerbridge Drive.	Residential landscaped areas
TRIB-O13 A	West side	Sample location is upstream of the tributary that crosses Outerbridge Drive.	Residential landscaped areas
TRIB-014	West side	Sample location is downstream of S2-TRIB-013 off of Davidson Road.	Anticipate that non-point pollution would be reduced in comparison with TRIB-013 due to presence of detention pond
TRIB-015	Northwest side	Stream located off of Rose Point Road.	Residential landscaped areas
TRIB-016	Northwest side	Unnamed stream flowing through the state forest	Runoff from forested area – may be representative of un-impacted runoff
TRIB-017 (DUPLICATE of 016)	Same	Same	Same
TRIB-018	Northwest side	Pickrel Cove Upstream.	Residential landscaped areas
TRIB-019	Northwest side	Pickrel Cove Downstream.	Anticipate that non-point pollution would be reduced in comparison with TRIB-018 due to presence of cove acting as a detention pond
TRIB-24	East side	Langley Brook.	Residential landscaped areas and roadway
TRIB-005	East side	Storm drain in driveway of Four Seasons (should have been labeled OUT – outfall)	Runoff from driveway and landscaped areas.
TRIB-20	Southeast side	Unnamed stream approx. 1/8 mile south of White Oaks Road.	Residential landscaped areas and commercial areas (restaurants & motels) - paved surfaces
TRIB-21	Southeast side	Black Brook (Upstream from TRIB-23)	Outlet at southern portion of Gilford Plaza parking lot - adjacent to a remediated leaking underground gasoline tank site (former gas station) as well as commercial (plaza parking lot) paved surfaces
TRIB-22	Southeast side	Outlet of Black Brook	Commercial use (fast food and commercial stores) paved surfaces
TRIB-23	Southeast side	Black Brook behind Paugus Dinner- just below storm drain outlet (upstream of TRIB 22)	Commercial use (restaurants and small stores) – paved surfaces

**TABLE B-4
PICKEREL COVE SAMPLING LOCATIONS**

Sample #	Area of Paugus Bay	Location	Anticipated Source of Rationale
PC1			
PC2			
PC3			
PC4			
PC5			
PC6			

Appendix C
Laboratory Analysis
for Paugus Bay

Appendix D
Laboratory Analysis
for Runoff Outfalls

Appendix E
Laboratory Analysis
for Tributaries

Appendix F
Laboratory Analysis
for Pickerel Cove